

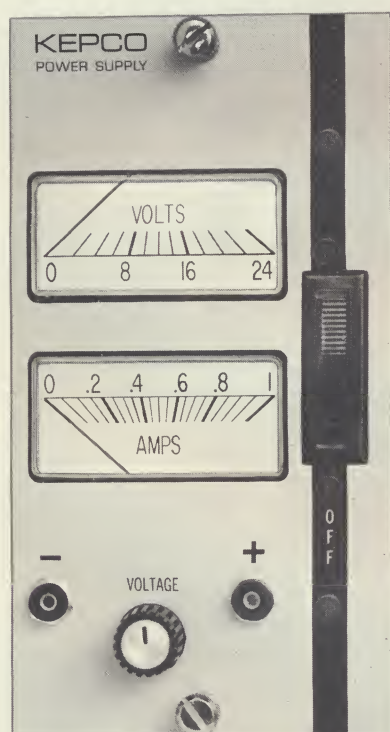
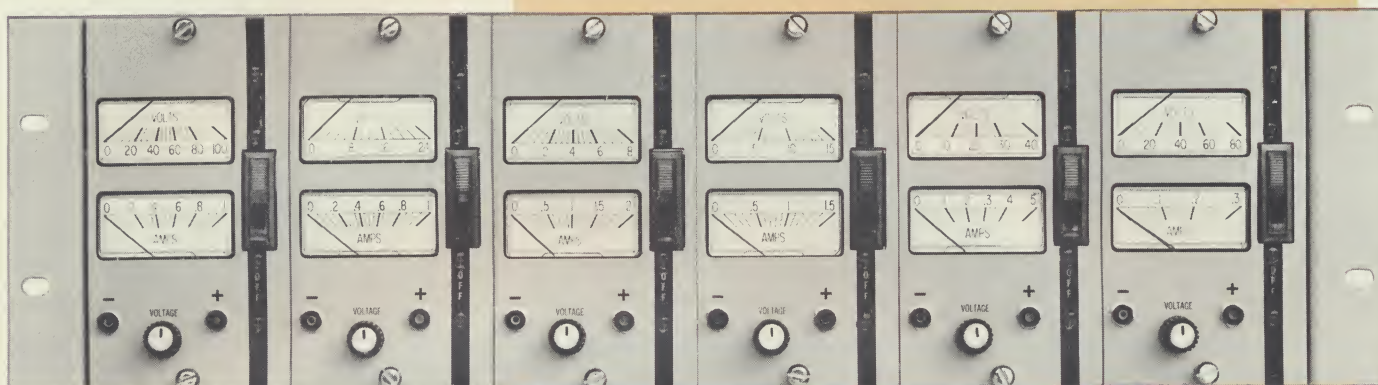
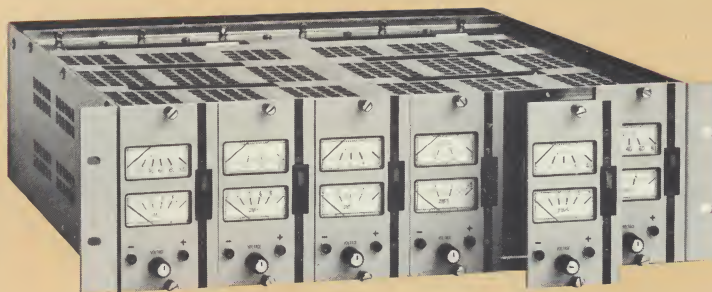


KEPCO

PBX-MAT

MODULAR POWER SUPPLIES

NEW KEPCO PRODUCTS *for '67*



The MAT attachment to Kepco's PBX models provides **meters** (two, for voltage and current); **adjustment**, (a multiturn voltage control); and **terminals** (pin jacks).

MODEL	DC OUTPUT RANGE		MAX. INPUT AMPS at 125V AC	PRICE
	VOLTS	AMPS		
PBX 7-2MAT	0-7	0-2	0.50	\$160.00
PBX 15-1.5MAT	0-15	0-1.5	0.65	160.00
PBX 21-1MAT	0-21	0-1	0.45	160.00
PBX 40-0.5MAT	0-40	0-0.5	0.40	160.00
PBX 72-0.3MAT	0-72	0-0.3	0.45	160.00
PBX 100-0.2MAT	0-100	0-0.2	0.45	160.00

SPECIFICATIONS: Same as for regular PBX Models; see Kepco Catalog B-663.

CASES: CA-3—Single slot housing w/plug board\$18.00
CA-4—Double slot housing w/plug board 24.00
CA-5—Triple slot housing w/plug board 30.00

RACK CABINET:

RA 22-6—Six slot housing w/o plug board* \$30.00
RFP 22-1—Single filler panel for RA 22-6 5.00
RFP 22-2—Double filler panel for RA 22-6 5.00
RFP 22-3—Triple filler panel for RA 22-6 5.00
BPA-22—Blank panel assy. w/slide plate 10.00
PC-2—Plug-in adapter 8.00

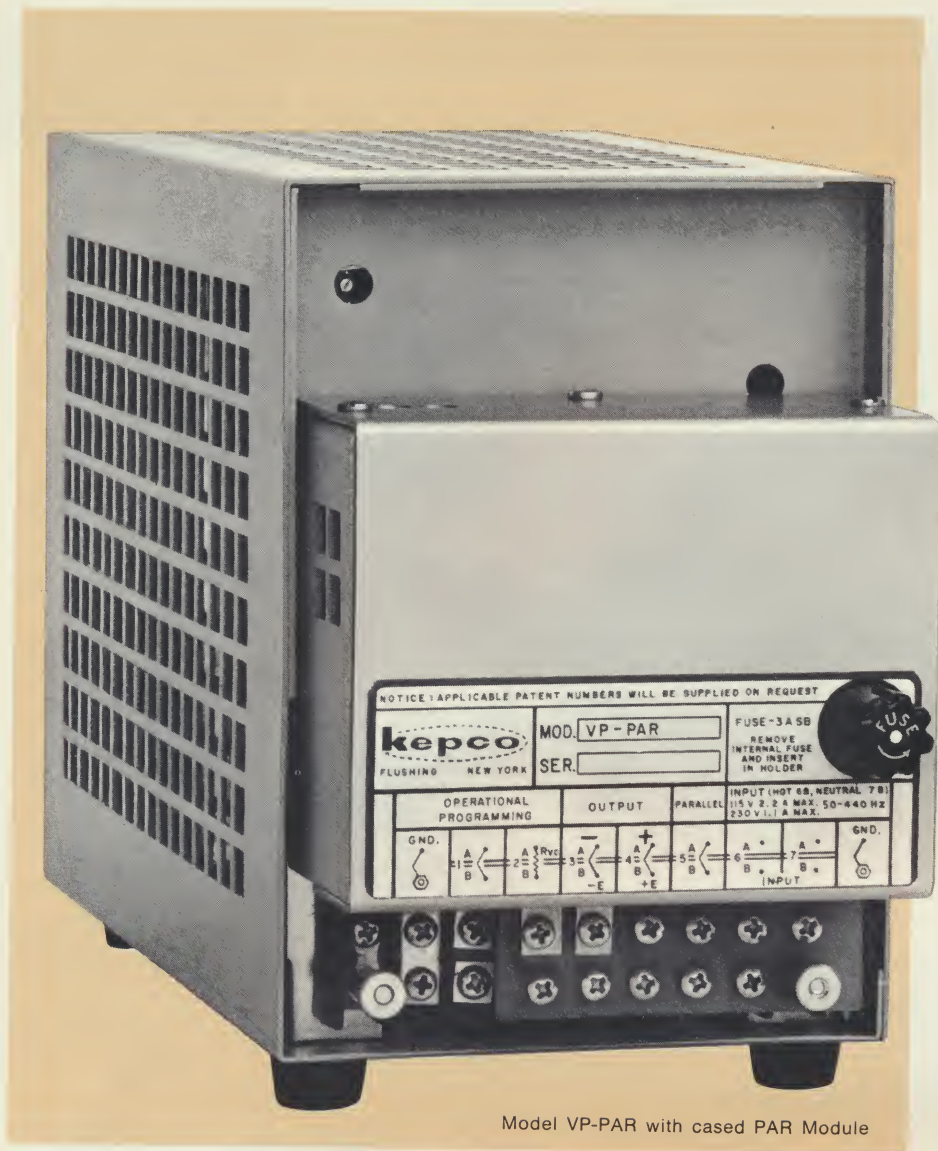
*For plug-in convenience in the RA-22-6, use (1) PC-2 per slot).

Data subject to change without notice
PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

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Cable: KEPCOPOWER NEWYORK



Model VP-PAR with cased PAR Module



KEPCO

OVERVOLTAGE PROTECTORS

Independently powered overvoltage crowbar prevents the output voltage from exceeding a preset voltage under any failure condition. The crowbar shorts the output through a Silicon Controlled Rectifier (SCR).

MODELS	USE WITH	PRICE**
VP-PAR	ALL KEPKO PAR MODELS, 3-80V DC	\$65.00
VP-PWR	ALL KEPKO PWR MODELS, 3-80 V DC	65.00
VP-PX-1	KEPCO PAX & PBX MODELS, 3-80V DC	65.00
VP-PX-2	KEPCO PAX & PBX MODELS, 3-160V DC	65.00

**Power supplies may be ordered with the overvoltage protector factory installed. Charges are \$25.00 each for 1 thru 11, \$10.00 each for 12 thru 23, and \$3.00 each for 24 or more.

SPECIFICATIONS: OPERATING LEVEL:

The trigger point may be set to within 5% or 0.25V* of power supply setting.

TEMPERATURE COEFFICIENT:

0.1% or 0.1V* per °C.

*whichever is greater

REMOTE ERROR SENSING:

Compensates up to 1 volt per output lead.

TRIGGERING TIME, (adjustable delay):

RANGE OF ADJUSTMENT	AMOUNT OF OVERVOLTAGE
10 to 30 microseconds	20% or 1 volt
20 to 60 microseconds	10% or 0.5 volt
40 to 120 microseconds	5% or 0.25 volt

All terms used in the specifications are defined in the Kepco Glossary. Refer to Kepco's Catalog or Handbook.



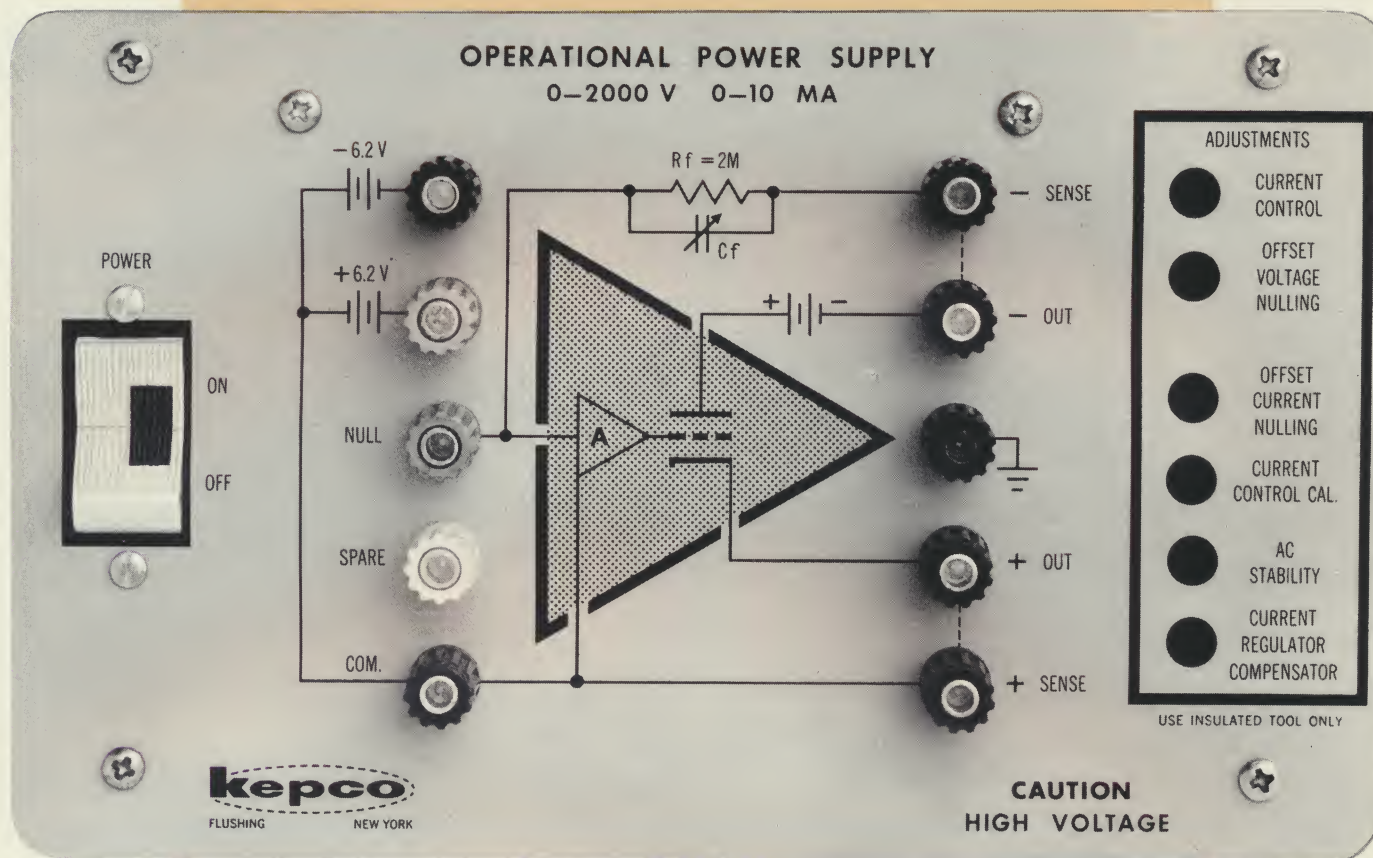
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KEPCO

HIGH VOLTAGE OPERATIONAL POWER SUPPLIES



MODEL OPS 2000 - 0-2000V / 0-10mA

SPECIFICATION	OFFSET VOLTAGE (ΔE_{io})*	OFFSET CURRENT (ΔI_{io})*
LINE: (105-125V AC)	< 100 microvolts	< 10 nanoamperes
LOAD: No load/full load	< 1 millivolt	< 10 nanoamperes
TIME: (8 hr.) (Stability)	< 10 microvolts	< 50 nanoamperes
TEMP.: Per °C (Coefficient)	< 50 microvolts	< 50 nanoamperes

* E_{io} is the offset voltage, I_{io} is the offset current referred to the input of the voltage comparison amplifier.

OUTPUT: 0-2000V DC, 0-10 milliamperes

SLEWING RATE: 500,000 volts per second.

DC VOLTAGE GAIN: 80 db.

RIPPLE: 80 db below peak output or 3 millivolts.*

TRANSIENT RESPONSE:

Voltage Mode (for step load current): Recovery is an exponential with 50 microsecond time constant.

Current Mode (for step load voltage): Recovery is at the rate of 0.5 volts per microsecond.

DIMENSIONS: OPS-2000 shares most of the specifications of the Kepco OPS Group, except size, which is 5¼"H x 8⅝"W x 13¼"D (behind panel).

FINISH: Panel: Per FED. STD 595. Color 26440, light gray.

Case: Gray hammertone. Rack adapters available.

PRICE: \$350.00

*whichever is greater

All terms used in the specifications are defined in the Kepco Glossary. Refer to Kepco's Catalog or Handbook.

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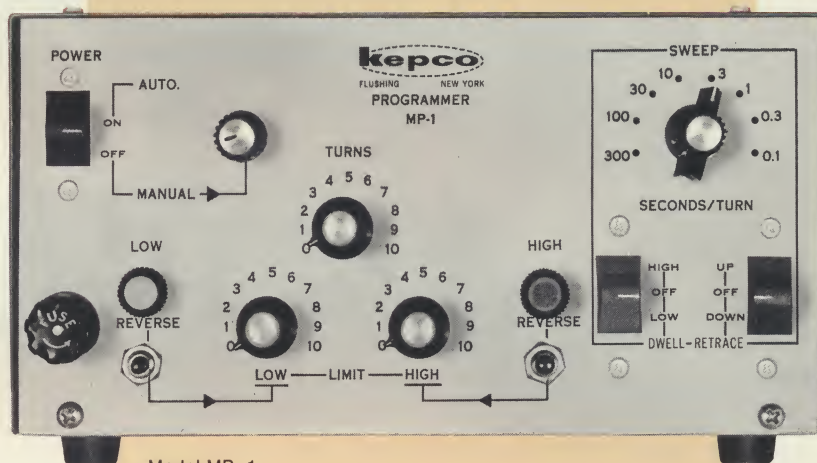
NEW KEPCO PRODUCTS for '67



KEPCO

MOTORIZED PROGRAMMERS

MECHANICAL FUNCTION GENERATOR



Model MP-1

Models MP-1 and MP-10 are mechanical drives for a 10-turn servo-mount potentiometer installed within. A synchronous motor drives the shaft through an 8-speed gear-box with adjustable limits.

MODELS	SECONDS PER REVOLUTION (MAXIMUM: 10 REVOLUTIONS, 3600°)								PRICE
MP-1	0.1	0.3	1.0	3.0	10.0	30.0	100.0	300.0	\$595.00
MP-10	1.0	3.0	10.0	30.0	100.0	300.0	1000.0	3000.0	595.00

TIMING ACCURACY: $\pm 5\%$ referenced to 60 cps line frequency.

INPUT: 105-125V AC, 60 cps

LIMITS, (Mechanically Adjustable):

Low Limit: Range from 0-9 $\frac{3}{4}$ turns.

High Limit: Range from $\frac{1}{4}$ to 10-turns.

Minimum Sweep Range: $\frac{1}{4}$ turn (120°)

OVERIDE: Manual override buttons reverse the sweep at any desired point—or manually stop the programmer.

DIRECTION SIGNALS: Pilot lights signal the direction of sweep up and down. With dwell and retrace off, sweep cycles symmetrically between limits.

DWELL: Stops the sweep at either the high or low limit, (selectable).

RETRACE: Selector causes the sweep to retrace up or down at maximum speed—no matter what the speed selected.

AVAILABLE POTENTIOMETERS: Any $\frac{1}{8}$ " shaft, $\frac{1}{8}$ " servo-mount potentiometer. Standard values: 10, 25, 50, 100 and 500 ohms; 1, 2, 5, 10, 30, 50, 75, 90, 100 and 125 kilohms. Other resistance values on special order.

TERMINALS: Rear mounted barrier strip contains speed changing connections: high and low limit contacts, dwell and retrace, and the output of the linear potentiometer.

DIMENSIONS: 4 $\frac{1}{4}$ "H x 9 $\frac{1}{2}$ "W x 9 $\frac{1}{2}$ "D.

FINISH: Panel: Per FED. STD 595. Color 26440, (light gray).

Case: Gray hammertone.

MOUNTING: Bench style, single and dual rack mounting adapters available.

Data subject to change without notice

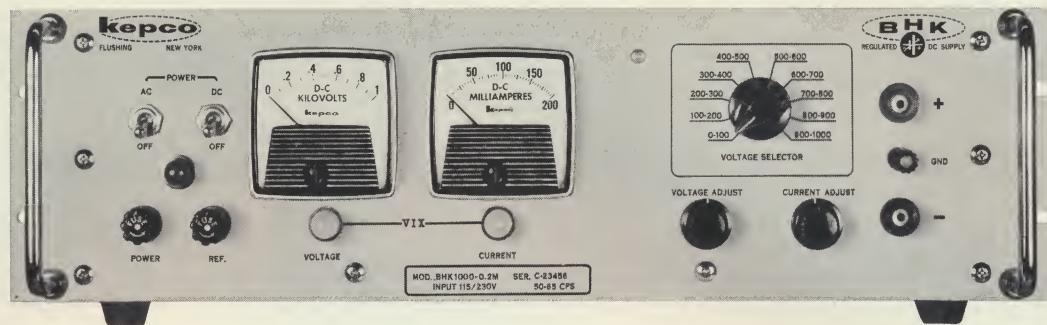
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KEPCO

BHK

HIGH VOLTAGE POWER SUPPLIES

- fast slewing capability
- operationally controlled
- hybrid design
- 10-turn voltage and current controls

MODEL	DC OUTPUT RANGE		OUTPUT IMPEDANCE			PRICE
	VOLTS	AMPS	Ohms + Microhenries	DC-100 cps	0.1-1kc	
BHK 500-0.4M	0-500	0-0.4	0.13	0.1	0.2 + 0.5	\$740.00
BHK 1000-0.2M	0-1000	0-0.2	0.5	0.1	0.2 + 0.5	740.00
BHK 2000-0.1M	0-2000	0-0.1	2.0	0.1	0.2 + 0.5	740.00

SPECIFICATIONS	VOLTAGE REGULATION	CURRENT REGULATION (Internal Sensing)	VOLTAGE AMPLIFIER OFFSETS**	
			ΔE_{io}	ΔI_{io}
OUTPUT RANGE:	0-100% E_o max.	0.2%-100% I_o max.	—	—
LINE: 105-125/210-250V AC	<0.005% or 1 mV*	<100 μ A	<1 mV	<10 nA
LOAD: No load/full load	<0.01% or 1 mV*	<100 μ A	<1 mV	<10 nA
TIME: 8 hours (Stability)	<0.01% or 2.0 mV*	<0.01% or 20 μ A*	<50 μ V	<50 nA
TEMP: Per °C (Coefficient)	<0.01%	<0.05% of I_o max.	<100 μ V	<50 nA
RIPPLE: rms (Normal Speed)	<1 mV	<100 μ A	—	—

*whichever is greater

** E_{io} is the offset voltage and I_{io} is the offset current referred to the input of the voltage comparison amplifier.

DC VOLTAGE GAIN: More than 100 db.

OUTPUT SLEWING RATE: (Fast slewing connection): Greater than 500,000 volts per second, measured as the chord to the first time constant on the exponential response.

SINUSOIDAL FREQUENCY RESPONSE:

Fast Slewing Connection: $f_{max} = \frac{160}{E_{pp}}$ kc.

(E_{pp} is the peak-to-peak excursion).

RIPPLE, Fast Slewing Connection:

Ungrounded: More than 60 db below peak output.

Grounded: More than 100 db below peak output.

TRANSIENT RESPONSE:

Voltage Mode, Fast Slewing: For step load current, recovery is an exponential with a 50 microsecond time constant.

Current Mode, Fast Slewing: For step load voltage, recovery is at the rate of 0.5 volt per microsecond.

Voltage Mode, Normal Speed: For step load current, recovery to regulation band within 50 microseconds.

OUTPUT IMPEDANCE:

Voltage Mode, Normal Speed: See table.

Voltage Mode, Fast Slewing: Above 1kc, add the reactive impedance of 500 microhenries.

OFFSET NULLING: The initial part of the input offset voltage and input offset current can be nulled with internal controls.

REFERENCES: Two: +6.2 volts and -6.2 volts; maximum current 1 milliamper.

PROGRAMMING: 1 mA control current, by resistance at 1000 ohms per volt. May be operationally controlled as an amplifier using voltage or current signals. Common positive.

AUTOMATIC CROSSOVER: Selects voltage regulation or current regulation operating mode automatically.

VIX® CIRCUIT: Voltage/Current mode indicators display operating conditions; also 115V AC control signal (0.5A max.)

REMOTE ERROR SENSING: Compensates up to 0.5V drop per output lead.

TEMPERATURE, AMBIENT OPERATING: -20°C to +55°C.

TEMPERATURE, STORAGE: -40°C to +85°C.

COOLING: Convection.

INPUT: 105-125 V AC or 210-250V AC (selected), 50-65 cps single phase. Approximately 4 amperes at 125V AC.

ISOLATION VOLTAGE: 1000 volts to chassis.

CONTROL RESOLUTION: Voltage: 0.01% 10-turn vernier control and 10 position selector. Current: 0.05% 10-turn control.

OVERSHOOT: (Turn-on/off): None above 10% voltage setting; negligible below 10% when preloaded to 10% minimum.

SERIES/PARALLEL: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-determined parallel load sharing.

METERS: Suffix "M" designates a pair of 2½", 2% meters. Delete suffix "M" for unmetred unit.

TERMINALS: Safety (recessed) output connections on front panel; two multi-terminal barrier strips at the rear contain output, sensing and control functions. Fast slewing/normal strapping is internal.

DIMENSIONS: 5¼"H x 19"W x 16½"D (behind panel).

FINISH: Per FED. STD. 595. Color 26440, (light gray).

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PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

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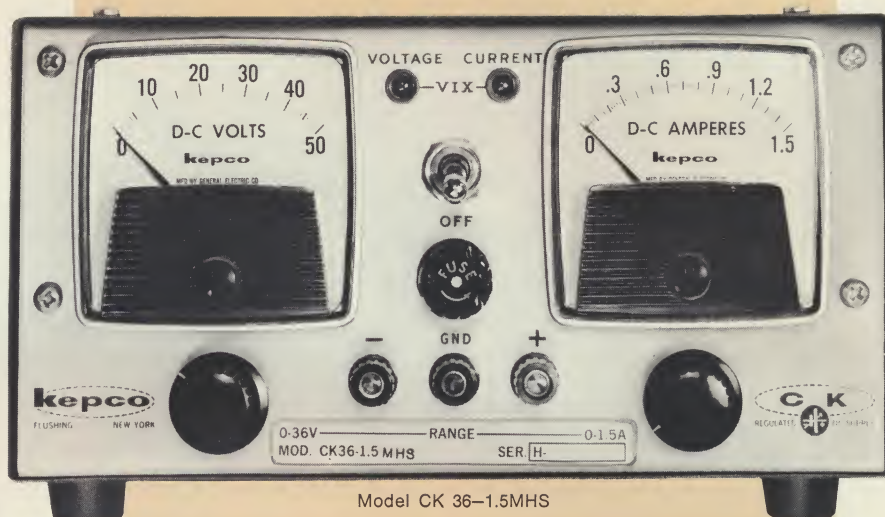
KEPCO

CK-HS

UNIPOLAR AMPLIFIER

POWER SUPPLIES

- fast slewing
- automatic crossover
- adjustable offsets



MODEL	DC OUTPUT RANGE		MAX. INPUT AMPS at 125V AC	PRICE
	VOLTS	AMPS		
CK 8-5MHS	0-8	0-5	1.2	\$390.00
CK 18-3MHS	0-18	0-3	1.3	350.00
CK 36-1.5MHS	0-36	0-1.5	1.5	350.00
CK 40-0.8 MHS	0-40	0-0.8	1.0	312.00
CK 60-0.5MHS	0-60	0-0.5	1.0	350.00

PARAMETER	VOLTAGE REGULATION	CURRENT REGULATION (Internal Sensing)	VOLTAGE AMPLIFIER OFFSETS**	
			ΔE_{io}	ΔI_{io}
OUTPUT RANGE	0-100% E_o max.	0.2%-100% I_o max.	—	—
LINE: 105-125/210-250V AC	<0.005% or 0.1 mV*	<0.005% or 0.2 mA*	<100 μ V	<10 nA
LOAD: No load/full load	<0.01% or 0.5 mV*	<0.01% or 0.2 mA*	<100 μ V	<10 nA
TIME: 8 hours (Stability)	<0.01% or 2.0 mV*	<0.05% or 1 mA*	<100 μ V	<10 nA
TEMP: Per °C (Coefficient)	<0.01%	<0.05% of I_o max.	<500 μ V	<50 nA

*whichever is greater

** E_{io} is the offset voltage and I_{io} is the offset current referred to the input of the voltage comparison amplifier.

DC VOLTAGE GAIN: More than 90 db.

OUTPUT SLEWING RATE: >100,000 volts/second (0.1V/ μ sec.) measured as the slope of the chord to the first time constant on the exponential response.

SINUSOIDAL FREQUENCY RESPONSE: $f_{max.} = \frac{32}{E_{pp}}$ kc.
(E_{pp} is the peak-to-peak voltage excursion.)

MAXIMUM CAPACITANCE LOADING: 0.001 microfarads. Excess capacitance slows response and causes peaking of response and instability. Adjustable lag networks provide for small range of load reactance.

RIPPLE: 60 db below peak output, or 10 mV rms (grounded).

TRANSIENT RESPONSE: Voltage mode (for step load current) recovery is an exponential with a 50 microsecond time constant. Current Mode (for step load voltage) recovery is at the rate of 0.1 volts per microsecond.

OUTPUT IMPEDANCE: At DC $Z_o = \Delta E_o / I_o$; dynamically, add the reactive impedance of 5 millihenries.

OFFSET NULLING: The initial part of the input offset voltage and input offset current can be nulled with internal controls.

REFERENCES: Two; +6.2V and -6.2V; maximum current 1 mA.

AUTOMATIC CROSSOVER: Selects voltage regulation or current regulation operating mode automatically.

VIX® CIRCUIT: Mode indicators display operating conditions, also produce a $\pm 8V$, ± 1 mA control signal.

REMOTE ERROR SENSING: Compensates up to 0.5V drop per output lead.

PROGRAMMING: 1 mA control current, by resistance at 1000 ohms per volt. May be operationally controlled as an amplifier using external voltage or current signals; common negative.

INPUT: 105-125V AC or 210-250V AC (selectable), 50-65 cps single phase.

TEMPERATURE, AMBIENT OPERATING: -20°C to +50°C.

TEMPERATURE, STORAGE: -40°C to +85°C.

COOLING: Forced lateral circulation, built-in blower.

ISOLATION VOLTAGE: 500 volts to chassis.

CONTROLS: 10-turn voltage and current controls, 0.05% resolution.

METERS: Suffix "M" designates a pair of 2½", 2% meters. Delete the "M" from the suffix to specify an unmetred unit.

TERMINALS: Binding posts on front panel, plus, minus, and ground. Sixteen (16) terminal barrier strip on the rear contains output, sensing, and control terminals.

DIMENSIONS: 4¼"H x 8½"W x 13½"D. Half-rack. Mounting accessories available.

FINISH: Panel: brushed aluminum; Housing: gray hammer-tone.

Data subject to change without notice
PATENT NOTICE: Applicable Patent Nos.
will be supplied on request.

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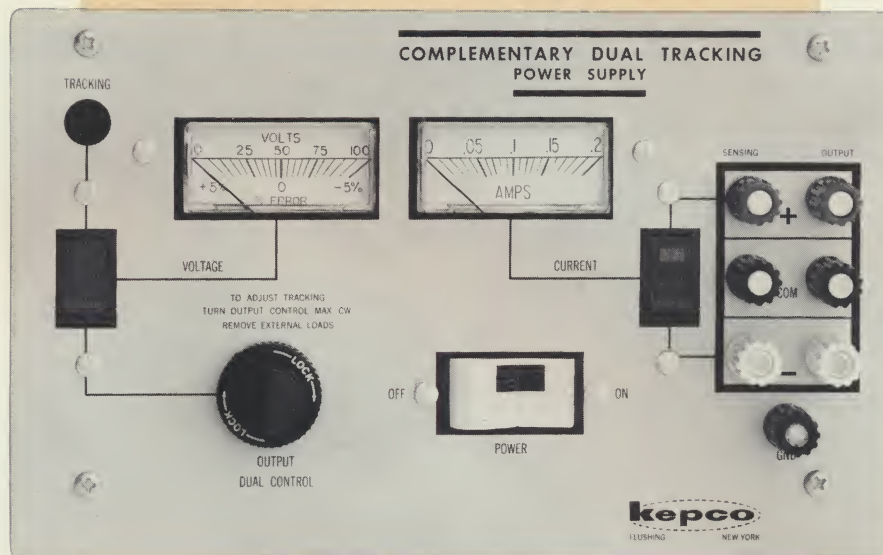


KEPCO

CDT

DUAL TRACKING POWER SUPPLIES

- complementary or series output
- single control, adjustable tracking
- voltage, current and error metering



Model CDT 100-0.2M

MODEL	TWIN OUTPUTS* COMPLEMENTARY SERIES				INDIVIDUAL SUPPLIES OUTPUT IMPEDANCE Ohms + Microhenries			MAX. INPUT AMPS at 125 V AC	PRICE
	VOLTS	AMPS	VOLTS	AMPS	DC-100 cps	0.1-1kc	1-100kc		
CDT 15—1.5M	0—±15	0—±1.5	0—30	0—1.5	0.001	0.02	0.1+1μh	1.3	\$380.00
CDT 40—0.5M	0—±40	0—±0.5	0—80	0—0.5	0.008	0.02	0.1+1μh	0.8	380.00
CDT 100—0.2M	0—±100	0—±0.2	0—200	0—0.2	0.05	0.02	0.1+1μh	0.9	380.00

*Each Power Supply contains two sources with a common voltage control, may be used as complementary (plus and minus) supplies or in series for double voltage.

SPECIFICATION	VOLTAGE MODE	
	COMPLEMENTARY**	SERIES
OUTPUT RANGE	0 to +E ₀ and 0 to -E ₀	0 to twice E ₀
REGULATION, LINE	< 0.005%	< 0.005%
REGULATION, LOAD	< 0.01% or 1mV*	< 0.01% or 2mV*
STABILITY (8 hr)	< 0.01% or 2mV*	< 0.01% or 4mV*
TEMP. COEFFICIENT	< 0.01% per °C	< 0.01% per °C
RIPPLE, rms	< 0.25mV	< 0.5mV

*whichever is greater

**Specifications are for the individual supplies, changes in the master supply (plus output) are repeated 1:1 in the slave supply.

INPUT: 105-125V AC or 210-250V AC (selected) 50-440 cps.

TEMPERATURE, AMBIENT OPERATING: -20°C to +65°C.

TEMPERATURE, STORAGE: -40°C to +85°C.

COOLING: Convection.

ISOLATION VOLTAGE: 500 volts to chassis.

OUTPUT: The individual power supplies are wired in series, controlled with a single voltage control. They may be loaded in series or separately.

CONTROL RESOLUTION: < 0.05%, 10 turn voltage control adjusts the output of the positive supply, designated "master", this voltage in turn controls the negative supply or "slave" in a 1:1 ratio. The two power supplies are connected in series.

TRACKING: ±5% range of adjustment is controlled by a recessed front panel control. Units can be adjusted to within ±0.5% using panel meter. Closer adjustment with external instrumentation.

PROGRAMMING: 1 milliamperere control current, or resistance: 1000 ohms per volt. Common positive.

VOLTAGE RECOVERY: (for step load current): < 50 μseconds.

CURRENT LIMITING: Each supply is individually limited with a 10 to 105% range of adjustment.

REMOTE ERROR SENSING: Compensates for up to 0.5 volt drop per output lead.

METERS: Voltmeter monitors output of MASTER, or the difference between MASTER and SLAVE, displayed as a percentage error (range ±5%). Ammeter monitors current from either supply (selectable).

TERMINALS: Binding posts on the front panel for plus, common and minus outputs, also sensing terminals and separate ground. Barrier strip at the rear has duplicate output, sensing and control terminals.

DIMENSIONS: 5¼"H x 8½"W x 17¾"D (behind panel).

FINISH: Panel: Per FED. STD 595, color 26440, light gray.
Case: Gray hammertone.

MOUNTING: Rack Adapters available.

Data subject to change without notice
PATENT NOTICE: Applicable Patent Nos.
will be supplied on request.

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KEPCO

PAR

MODULAR

POWER SUPPLIES

- overload current cutoff
- out-of-band programming
- precision regulator
- conventional transformer

MODEL	OUTPUT† VOLTS	OUTPUT CURRENT at ambient temp		OUTPUT IMPEDANCE			PRICE
		65°C † 55°C ††	40°C † 30°C ††	Ohms DC to 100 cps	+ Microhenries 100 cps to 1 kc	1 kc to 100 kc+μh	
PAR-4	4±5%	0-9.0	0-11.0	0.0001	0.005	0.1+0.5	\$195.00
PAR-7	7±5%	0-8.0	0-10.0	0.0001	0.005	0.1+0.5	195.00
PAR-12	12±5%	0-5.5	0-7.0	0.0002	0.005	0.1+0.5	195.00
PAR-15	15±5%	0-4.6	0-6.0	0.0003	0.005	0.1+0.5	195.00
PAR-24	24±5%	0-3.4	0-4.0	0.0006	0.005	0.1+0.5	195.00
PAR-28	28±5%	0-3.1	0-3.7	0.0008	0.005	0.1+0.5	195.00
PAR-36	36±5%	0-2.3	0-2.8	0.0015	0.005	0.1+0.5	195.00
PAR-48	48±5%	0-1.8	0-2.3	0.0022	0.005	0.1+0.5	195.00
PAR-60	60±5%	0-1.5	0-2.0	0.003	0.005	0.1+0.5	195.00

†Uncased ††Cased

SPECIFICATION	VOLTAGE MODE	CURRENT MODE** (External Sensing)
OUTPUT RANGE	±5% †	1 mA to I_{limit} cutoff locus
REGULATION, LINE	<0.005%	<0.005% at rated sample**
REGULATION, LOAD	<0.01% or 0.5 mV*	<0.01% at rated sample** †
STABILITY (8 HR.)	<0.02% or 2 mV*	<0.02% or 1 mA
TEMP. COEFFICIENT	<0.02% per °C	<0.02% per °C at rated sample**
RIPPLE, rms	<0.25 mV	<0.01% of I_0 max.

*whichever is greater

**Rated sample is 1 volt across external current sensing resistor with external current control.

†Adjustable to zero with corresponding current derating (see operating region graph).

‡The compliance voltage range lies within shaded operating region from the I_{limit} locus to 105% E_0 max.

INPUT: 105-125V AC or 210-250V AC, (selected), 50-440 cps single phase; approximately 2 amperes, 200 watts.

TEMPERATURE, AMBIENT OPERATING: Uncased: -20°C to +65°C maximum (see rating chart). Cased: -20°C to +55°C maximum (see rating chart).

TEMPERATURE, STORAGE: -40°C to +85°C.

COOLING: Convection.

ISOLATION VOLTAGE: 500 volts to chassis.

CONTROL/PROGRAMMING: ±5% internal trimmer (voltage or current). External resistance programming ratio is 1000 ohms per volt. A 1% fixed resistor is supplied to program the tabulated nominal voltage. When programmed below the ±5% output band, derate current per operating region graph.

VOLTAGE RECOVERY (for step load current): <50 μseconds.

OVERLOAD CURRENT CUTOFF: Adjustable cutoff locus pivots about the $E_0 \approx 0$, $I_0 \approx 5\%$ point, reducing the output current into an overload. Note: Nonlinear loads drawing a high starting current may be locked out by the cutoff locus, and require a starting resistance to be contained within the shaded regions of the operating region graph.

Data subject to change without notice

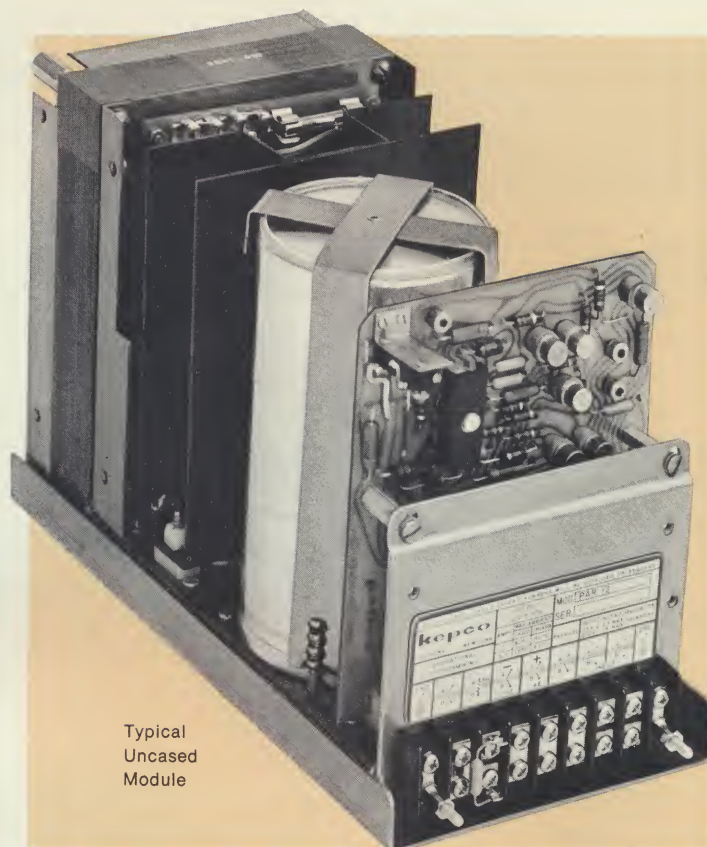
PATENT NOTICE: Applicable Patent Nos. will be supplied on request.

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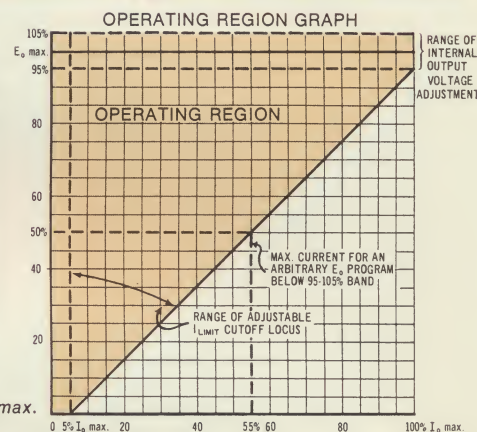
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Typical
Uncased
Module



REMOTE ERROR SENSING: Compensates for up to 0.5 volt drop per output lead.

OVERSHOOT: (Turn-on/off): None in ±5% operating band. When output is set below 25%, load to approximately 10% to maintain negligible overshoot.

SERIES/PARALLEL: Connections are provided for parallel operation of identical units. Series operation to rated isolation.

OVERVOLTAGE PROTECTOR: Provision is made for attachment of an optional crowbar overvoltage protector, type VP-PAR. See accessory listing for detailed description of protector.

TERMINALS: All input, output, sense and control connections are made via a single multiterminal barrier strip.

DIMENSIONS: Uncased: 6¼"H x 4¼" W x 10¾"D.
Cased: 6½"H x 5" W x 10¾"D.

FINISH: Case: Royal blue epoxy.

MOUNTING: Rack mounting panel adapters available.





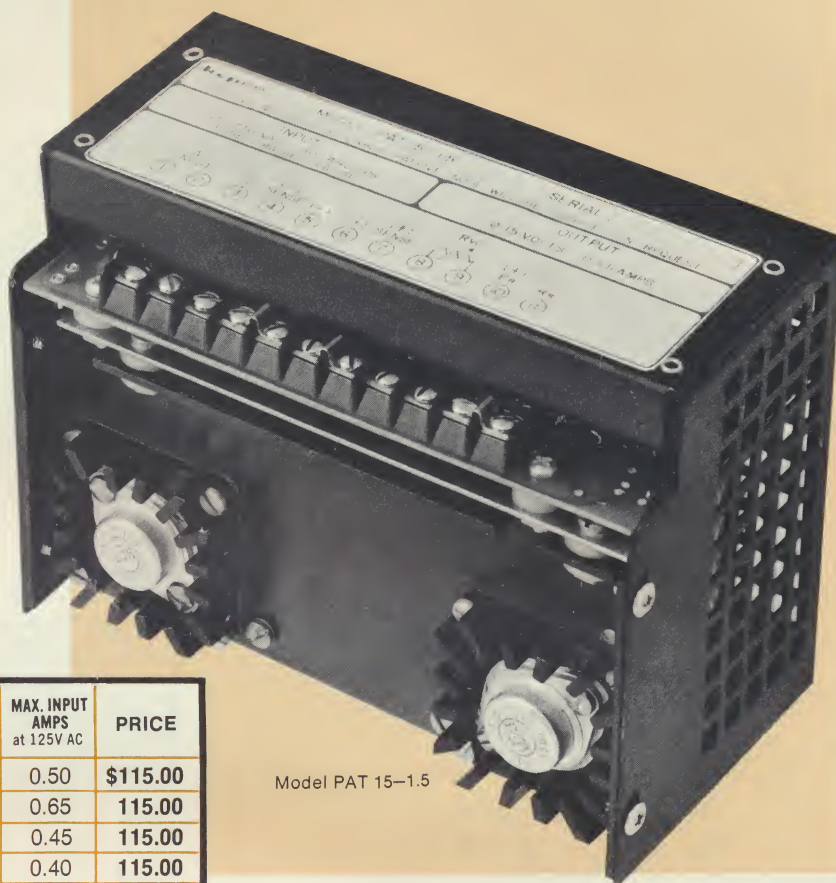
KEPCO

PAT

MODULAR

POWER SUPPLIES

- voltage/current regulation
- full range operationally programmable
- all silicon design



Model PAT 15-1.5

MODEL	DC OUTPUT RANGE		OUTPUT IMPEDANCE			MAX. INPUT AMPS at 125V AC	PRICE
	VOLTS	AMPS	Ohms + Microhenries	DC-100cps	0.1-1kc	1-100kc	
PAT 7-2	0-7	0-2	0.0005	0.02	0.1+1	0.50	\$115.00
PAT 15-1.5	0-15	0-1.5	0.001	0.02	0.1+1	0.65	115.00
PAT 21-1	0-21	0-1	0.0025	0.02	0.1+1	0.45	115.00
PAT 40-0.5	0-40	0-0.5	0.008	0.02	0.1+1	0.40	115.00
PAT 72-0.3	0-72	0-0.3	0.025	0.02	0.1+1	0.45	115.00
PAT 100-0.2	0-100	0-0.2	0.050	0.02	0.1+1	0.45	115.00

SPECIFICATIONS	VOLTAGE MODE	CURRENT MODE** (External Sensing)
OUTPUT RANGE	0-100% E_O max.	1mA-100% I_O max.
REGULATION, LINE	<0.01%	<0.01% at rated sample**
REGULATION, LOAD	<0.01% or 1 mV*	<0.02% at rated sample**
STABILITY (8 HR.)	<0.01% or 2 mV*	<0.05% or 1 mA*
TEMP. COEFFICIENT	<0.01% per °C	<0.05% per °C
RIPPLE, rms.	<0.1 mV	<0.02% of I_O max.

*whichever is greater

**Rated sample is 1V DC across external current sampling resistor with external current control.

INPUT: 105-125V AC or 210-250V AC (selected), 50-440 cps single phase.

TEMPERATURE, AMBIENT OPERATING: Cased: -20°C to +71°C.

TEMPERATURE, STORAGE: -40°C to +85°C.

COOLING: Convection.

ISOLATION VOLTAGE: 500 volts to chassis.

PROGRAMMING: Approximately 1 mA control current, externally adjustable by resistance at ≈ 1000 ohms per volt. Specify suffix "R" to obtain model with integral $\pm 10\%$ control current adjustment. May be operationally controlled as an amplifier using voltage or current signals; common positive.

VOLTAGE RECOVERY (for step load current): <50 μ seconds.

CURRENT LIMITING: Adjustable from 10% to 105% of rated full current.

REMOTE ERROR SENSING: Compensates up to 0.5 volt drop per output lead.

OVERSHOOT (Turn-on/off): None above 25% voltage setting; negligible below 25% when preloaded to 10% minimum.

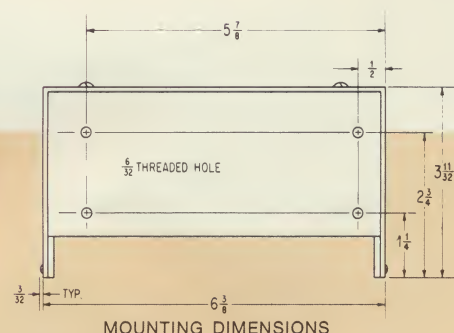
SERIES/PARALLEL: Series operation to rated isolation; also master/slave capability. Current limiting design permits self-terminated parallel load sharing.

TERMINALS: All input, output and control connections are made via a multi-terminal barrier strip.

DIMENSIONS: Cased: $3\frac{15}{32}$ "H x $6\frac{5}{8}$ "W x $4\frac{29}{32}$ "D.

FINISH: Black anodized aluminum.

MOUNTING: Rack Adapters available.



MOUNTING DIMENSIONS

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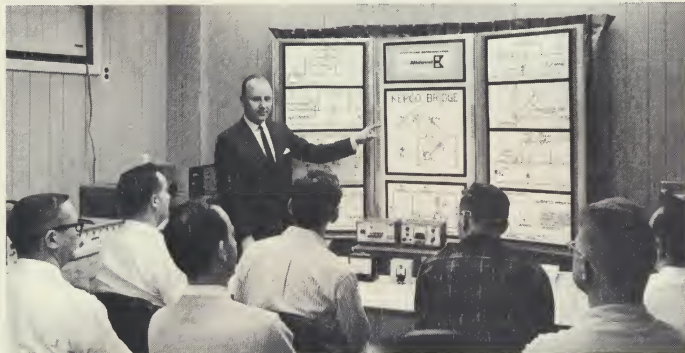
Data subject to change without notice
PATENT NOTICE: Applicable Patent Nos.
will be supplied on request.



#146-1168 LITHO IN U.S.A.



KEPCO-MIDWEST SEMINAR ON TOUR



Midwest's Bernie Menarik discusses the programming capabilities of the basic Kepco Control Bridge with a seminar group.

Midwest Electronic Sales, Kepco's representatives for South Wisconsin, Eastern Iowa, Northern Illinois, Indiana, and Kentucky, has developed a very successful "on the spot" in-plant Kepco Seminar program. Although recently inaugurated, these seminars have already achieved considerable popularity with the many industrial, electronic and research firms in Midwest's area. It brings to interested technical audiences the latest operational control techniques developed by Kepco which range far beyond the front knob control limits most commonly associated with the use of power supplies. The lecture material, based on the Kepco Power Supply Handbook, is presented in a clear and informative manner, and has proven very useful to engineers and technicians. In fact, several universities have responded very favorably to these Midwest-Kepco Seminars.

Continued on Page 4 - Col. 1

NEW HIGH-VOLTAGE OPERATIONAL POWER SUPPLY/AMPLIFIER

In the new BHK Series High Voltage Power Supply /Amplifier, Kepco has chosen to use a fully dissipative regulator design. Although this requires more pass elements and greater heat dissipation, by avoiding the use of any preregulators, the power supply is made much less restricted in terms of bandwidth, dissipation, and output range. One kind of preregulator used previously to limit dissipation in Kepco's own HB design, relied on the selection of secondary taps on the power transformer to keep the voltage across the pass element minimized. Primarily, the objective, in the case of the HB design, is to keep the *dissipation* minimized where the pass tubes are able to take the *voltage*. Other design methods, include variable auto-transformer tracking, as in the HB 2050 and the HB 2500 power supplies, (in which the purpose is to keep the voltage within the capabilities of the pass tubes).

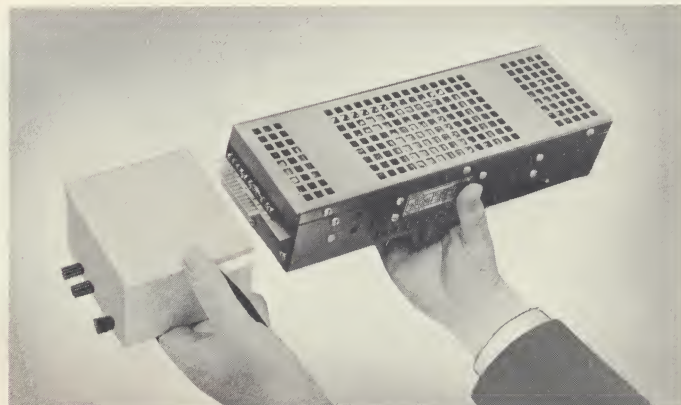
All of these methods of preregulation or dissipation control, in some way limit the flexibility of the power supply. Other

Continued on Page 2 - Col. 1

THE HI FI POWER SUPPLY

Need an audio amplifier? Faced recently with a requirement for a small public address amplifier, Kepco engineers decided to see what would happen if they hooked a microphone or phono unit input to one of the new, fast slewing DC power supplies. The results: beautiful music! The Hi Fi Power Supply, as it is known, has been traveling ever since, serving as the PA amplifier for Kepco's lecture series (on the "Op-Amps . . . with muscle," see *EEE Magazine*, June, 1966).

This vocal power supply has elicited many questions from audio-minded engineers that we hope this close-up view will help answer and, perhaps, inspire others. We have no illusions that fast slewing power supplies should be promoted as audio amplifiers, but the bandwidth-gain so illustrated is indicative of the variety of instrumentation tasks that can be handled by such equipment.



MICROPHONE PRE-AMP PLUG-IN ATTACHMENT WITH MODEL PAX 7-1CHS POWER SUPPLY

The versatility of which we speak derives from the power supply's ability to be easily modulated; that is, to have its output varied as a linear function of input or command signals. All of Kepco's programmable DC supplies have this capability. They may be modulated by a changing resistance/voltage/current and/or conductance, and like operational amplifiers, can be made to respond in specific, predictable ways to such excitation. Dynamically, the usual power supply's output and feedback filter-capacitors severely limits the bandwidth of signals that can be accommodated. For practical purposes, the conventional power supply is limited to quasi-static programs whose dynamic rate-of-change does not exceed a few hundred volts per second.

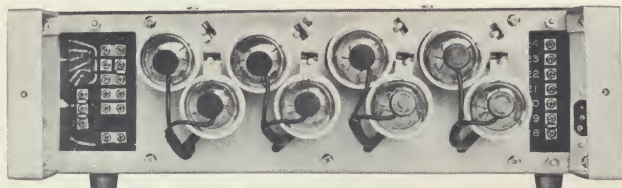
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methods which have been used include "the piggy back" design, (with similar limitations), and switching preregulators, which are semi-conductors in low level voltage circuits, switched on and off at various frequencies. This technique produces non-harmonic frequency components in the output, however, which are disadvantageous.

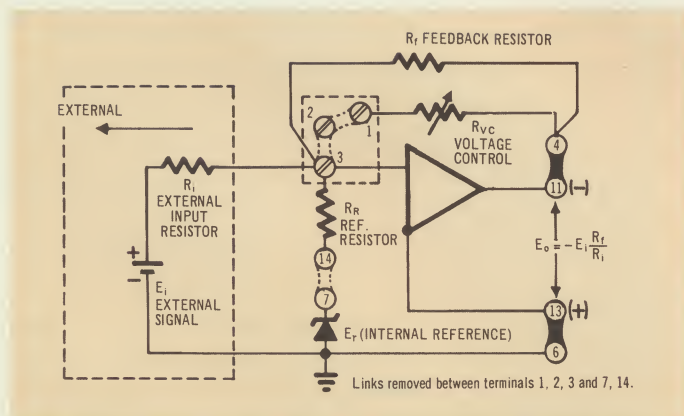
All of these techniques depend on "trading off" one performance feature for another. We have chosen in the new BHK design, a fully dissipative route, in which we do not "trade off" any performance at all. Instead, we have dealt directly with the problem of heat dissipation, rather efficiently by using vacuum tube pass elements which operate at high temperatures. The heat transfer problem is considerably less than with transistors, where the temperature differential between the dissipating element and the outside temperature would be relatively small.



TYPICAL REAR VIEW BHK POWER SUPPLIES SHOWING PASS AND CONTROL TERMINALS.

The type 8068 pass tube is particularly well designed for this kind of service. It has a 3500 volt plate to cathode rating, a 35 watt plate dissipation rating, 5200 μ mhos trans-conductance, and yields very high gain. As a matter of fact, the tube gives so much gain in this particular circuit that the overall loop gain approaches 120 db, (although the closed loop gain is only specified as >100db). This means that although the power supply's temperature compensated six volt reference is amplified up to the 500, 1000, or 2000 volt output level, (the operational gain, or amplification is better than 83,167, or 333 times, respectively), the remaining, so-called "loop gain", which determines the regulating capability, will still exceed 60 db. In order to have a well-regulated high voltage power supply, it is obviously necessary to have very high gain circuits.

Rather than letting all this gain go to waste, we have designed the BHK power supply so that there is convenient access to all the necessary control points in the circuit. The gain can be used as though it were an amplifier, with a signal applied to a pair of input terminals, and an output taken from



TYPICAL BHK OPERATIONAL AMPLIFIER CONFIGURATION.

another pair. The BHK, then, is a unipolar, high voltage DC amplifier.

We have made provision for *fast slewing connections*, in which the filter capacitors, that are normally used when the power supply is functioning as a power supply, can be removed. The bandwidth of the unit without the filter capacitors is large enough so that the power supply is extremely useful as an instrumentation amplifier.

For example, from the chart that is reproduced elsewhere in this issue, a 500,000 volt/second slewing rate with a 100 volt peak to peak wave form is capable of 1.6 kc bandwidth, and at the 10 volt peak to peak level, 16 kc. For a 1 volt peak to peak excursion, the bandwidth is increased to 160 kc. This is a sufficiently wide bandwidth to make the device useful in signal following and processing applications, and as a quick responding current source, among other possible applications.

When the power supply is operating as a current source, it is effectively self-programmed. Its voltage will follow the load resistances in an automatic fashion. Therefore, the user has to think in terms of the slewing rate of the output to determine what the recovery time of the device would be as a current regulator. In this case, the recovery time would be better than 0.5 volt per microsecond.

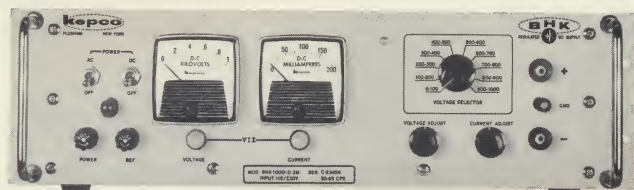
As a power supply, fast programmed from one voltage level to another throughout its range, the ability to get to a new voltage, and settled at that voltage, is enormously improved by this fast slewing capability. It is possible to step from 0 to 1000 volts, for example, in <2 milliseconds. This by comparison, might take 4 seconds, if the power supply were functioning with its normal output capacitor.

The settling time is a function of the damping ratio of the power supply. Provisions are made to set it up for an underdamped, overdamped, or critically damped response. The method that has been provided takes the form of an adjustable feedback capacitor in parallel with the voltage control. Assuming a 1 milliamperere control current, a selection of fixed ceramic capacitors, from 50 to 3900 picofarads is provided. These can be connected in parallel in various combinations. The range of feedback capacitance is such that it is possible to set the power supply either for an underdamped state (in which the output voltage overshoots its final value, oscillates once or twice about the ultimate value and then settles down), a critically damped state, or a considerably overdamped state in which the voltage approaches its final value in an asymptotic fashion. The maximum programming speed occurs when the system is somewhat underdamped, and overshoots perhaps once, and then settles back to its final value. This relationship is treated in many textbooks on servomechanisms or feedback control systems.

The BHK power supply is also an automatic crossover power supply. Because of its full dissipation capability, it has the ability to operate as a current regulator from zero to its maximum rated output voltage, without any current derating restriction. Consequently, Kepco has built in the automatic crossover circuit. In effect, we have built-in a full amplifier to detect the voltage across an internal current sampling resistor, producing a signal proportional to the output current. There is a complete gate circuit which allows the pass tubes to choose between the signal from the voltage amplifier and the signal from the current amplifier. A VIX[®] circuit in the power supply displays the position of the gate on the front panel, and also provides a signal at the rear. In this power

supply, the VIX® signal is 115V AC.

Like all of the Kepco automatic crossover power supplies, this one contains a pair of output controls on the front panel, a ten-turn voltage control, and a ten-turn current control. Since the voltage control must cover a relatively wide voltage range, a ten position range switch and ten-turn vernier control is provided. In the case of the Model BHK-1000-0.2M, the range switch has ten steps of 100 volts per step, and the 10-turn control need only cover a 100 volt span. The current control does not have this kind of problem, since it has only a few hundred milliamperes of range, and is adequately covered by a single 10-turn control. The voltage control's step selector does not limit the programming of the power supply. The switch is there for the purpose of increasing the resolution in the setting of the output voltage and also to circumvent the problem of supporting all the output voltage across a single control. Since all resistors have a voltage coefficient, that is to say, their resistance changes as a function of the voltage being supported across their terminals, it is desirable to keep that voltage small, and this the ten position switch accomplishes. The switch is *not* doing any switching in the *primary* or the *secondary* of the transformers. It is *not* in any way limiting the dissipation inside the power supply, and so it has *no limitation* on the programming function of the power supply, or on its range of operation as a current regulator.



FRONT PANEL VIEW MODEL BHK 1000-0.2M

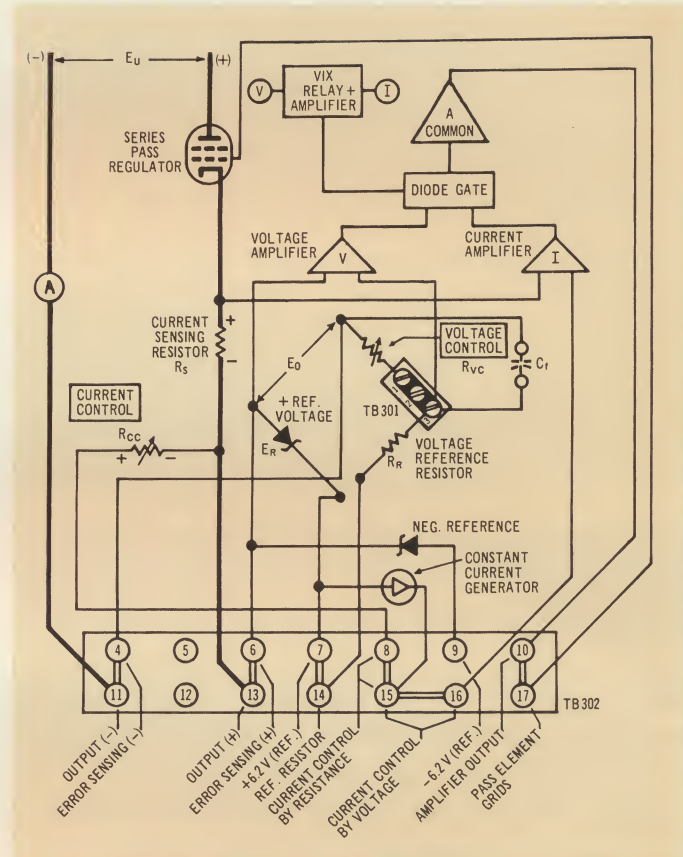
The front panel output connectors on the BHK are specially designed for safety. They are recessed, so that all accidental contact can be minimized. All the programming function and output terminals are, of course, provided on the back of the supply, behind lucite safety panels.

The controls which are provided on the BHK power supply are unique in the power supply industry for their completeness and variety. In addition to the front panel voltage controls and current controls, the designers of this power supply have built into it primary offset compensation controls, which recognize the existence of offset ratings, and their importance. These offset controls enable the user to precisely zero all of the non-idealities of the amplifiers.

Non-idealities can briefly be divided into two parts; the fixed parts of the offset voltage, and the offset current. In the BHK, there is an offset voltage adjustment having a plus-minus 120 millivolt range. It is a 25-turn trimmer built into the power supply. There is an offset current compensator having a 0-12 microampere range, which will zero the offset current into the voltage amplifier. There are a pair of calibrators, which effectively set the control current, one for the voltage amplifier, having a plus-minus five percent range, and the other for the current amplifier, again having a plus or minus five percent range. Both of them are 25-turn trimmers.

There are two adjustable AC lag networks, which provide for AC stability, when the output filter capacitors are unstrapped for fast slewing operation. With the removal of the capacitors, the phase gain margin of stability is greatly reduced. To operate without the output capacitor, it is necessary to work into a

purely resistive load. This is important, and one must adjust the internal lag networks to compensate for whatever residual reactance does appear across the load terminals. This is an adjustment which is common to all the high speed or fast slewing power supplies. In addition, there are the feedback capacitors which have been discussed previously. There are four of them, and adjustment of them is by internal strapping. The last control, internal to the power supply, is called the *current compensator*, a control found on all Kepco automatic crossover power supplies. It adjusts the current regulator to compensate for such shunt conductance loads as the power supply's own voltmeter, as well as the control current of the voltage regulator, and other bleed paths which cannot be removed readily.



SIMPLIFIED DIAGRAM OF THE BHK POWER SUPPLIES WITH REAR TERMINAL CONNECTION DETAILS.

A temperature controlled oven is provided around the precision reference zener diode. This is necessary, because the design philosophy of the Kepco comparison bridge is to *multiply* the reference up to the level of the output, and do the critical voltage comparison on a *one-to-one basis*, rather than *dividing* the output *down* to the level of the reference. This technique enables the power supply to operate without dividing its errors, because there is no division of error, the power power supply can detect millivolt errors resulting in a superlative regulator specification: "0.01% or 1 millivolt, whichever is greater". This *does* impose a great burden on the reference. The reference has to be able to be multiplied without degrading the stability specifications. We have chosen a reflex circuit to feed a stable current to the zener in a precise fashion, so that it is well isolated from the power-line, and to enclose that zener in a proportional oven-controlled environment. The current through the zener is maintained extremely constant,

no matter what the output setting of the power supply. This yields a very high grade reference indeed.

The BHK power supplies are 19" wide (standard rack), 5¼" high and 16½" deep. The vacuum tubes that dissipate all the heat are at the rear of the power supply, which permits free air circulation, but keeps them physically isolated from the temperature sensitive circuits located near the front panel. There are no blowers, nor is there any need for external forced air.

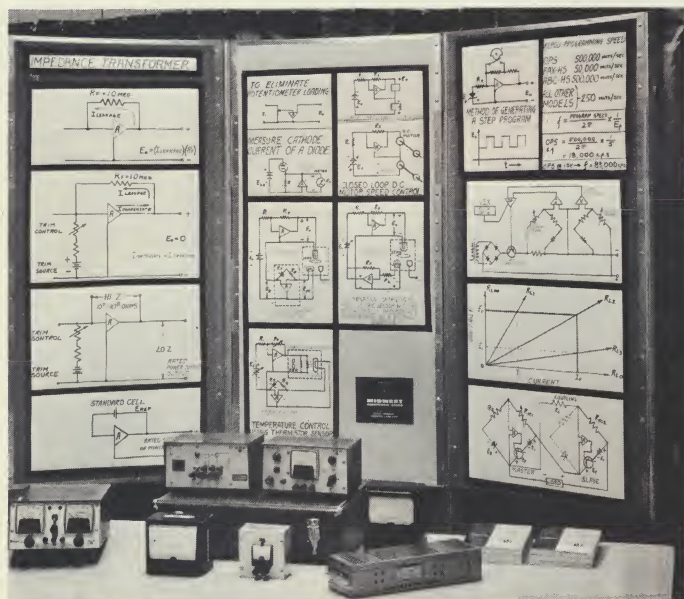
KEPCO-MIDWEST SEMINARS ON TOUR

Continued from Page 1 - Col. 1

The seminars highlight many of the concepts in the Kepco Power Supply Handbook. Following the demonstrations, those attending the seminars find reference to the Handbook easier, more directly meaningful, and are also encouraged to make more sophisticated utilization of Kepco Power Supplies. A personal copy of the Kepco Power Supply Handbook is provided to those in attendance.

Midwest's Bernie Menarik and his associates are frequently invited to present the seminar before groups from just a few, to as many as twenty-five persons.

The seminar, presented in three parts, features a two sided, three partition, aluminum fold-away panel, which effectively displays 24 key block diagrams. Also included as part of the demonstration are five typical Kepco Power Supplies, which are actually in operation, with input or output voltages displayed and loads connected. After a thorough explanation of the patented Kepco bridge circuit, the seminar moves into the operational amplifier concept of programmable Kepco power supplies.



Power Supplies and lecture diagrams used in the Kepco-Midwest Seminars.

Part 1 covers all phases of voltage programming, with emphasis on input impedances, amplifier gain, and summing features. Particular stress is placed on how the operational programming features are realized at full rated output current of the power supply under consideration. Resistance programming follows, with emphasis on how the Kepco supply can be used as a precision voltage reference source.

Part 2 begins by turning and reversing the fold-away dis-

play panel, which introduces each subject with simplified operational diagrams. A novel feature of the presentation, for many Kepco users and prospects, is the thorough analysis of how any programmable Kepco power supply can be converted to a unity gain impedance transformer, repeating input voltages at full rated output current. One of the highlights of the demonstration is a standard cell repeater connection measuring only 10-15 nanoamps through a reference voltage cell. This very high impedance and low source current drain, once established, can be used to repeat *any* voltage with current amplification. Various industrial applications are shown where Kepco power supplies utilize external load sensors for "servo-feedback" closed-loop control purposes; for example, motor speed and illumination control, controlled temperature chambers, chemical process control, etc. Actual demonstrations of solar cell and thermistor sensors are shown, with free sample thermistors given to participants.

Part 3 follows with discussion and demonstration of constant current applications, and how they can be effectively employed for laboratory and industrial uses. The seminar concludes with a detailed discussion of programming speeds and various applications which can employ the fast-slewing capabilities of Kepco's expanding line of high-speed programmed power supplies.

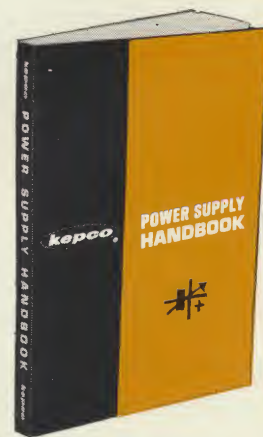
If you are in the Indiana, Illinois, Iowa, Kentucky or Wisconsin area, and are interested in having this informative seminar conducted for technical personnel at your facility, please contact your local Midwest Electronic Sales Engineer, or Midwest Electronic Sales, 5707 W. Division Street, Chicago, Illinois 60651. Telephone: 626-0300. Area Code 312. In other areas, contact your closest Kepco technical representative, who has been trained in similar presentations.



B.A. Menarik, Kepco's midwest representative, has been senior partner in Midwest Electronic Sales since 1959. He initiated and developed the Kepco-Midwest Seminar Series described in this article. Since receiving his BS Degree in Electrical Engineering from Notre Dame University, his experience has covered sales, engineering and teaching. He has contributed greatly to the success of the training sessions for Kepco's Sales Representatives held recently in New York.

HANDBOOK DEMAND CONTINUES!

The Kepco Power Supply Handbook expounds in several forms the Kepco operational concept for regulated power supplies, treating the signal flow rather than the power flow as a way of better understanding their intrinsic capabilities. With the introduction of the new high speed CK (CK-HS) line of power supplies, and the remarkable BHK group, the applications information in the Handbook is more valuable than ever. If you haven't already obtained a personal copy, write on your company's letterhead to: Publications Manager, Dept. K, Kepco, Inc., G.P.O. Box 67, Flushing, New York 11352.



In the Kepco HS (high speed), fast slewing, and the unique OPS (operational power supply) designs, elimination of the output and feedback capacitors results in enormously quickened slew rates producing relatively wide usable bandwidth. Speeds from 50 to 500 kilovolts per second (0.05 to 0.5 volts per microsecond) are routinely achieved, with equivalent bandwidths to 20 kc. Bandwidth is a function of excursion, being the slew rate / π $E_{peak-peak}$ (see Figure 1). When the filters are removed from a power supply, other means must be employed to stabilize the high gain amplifier; these take the form of integral adjustable lag networks, without which filter removal is not possible.

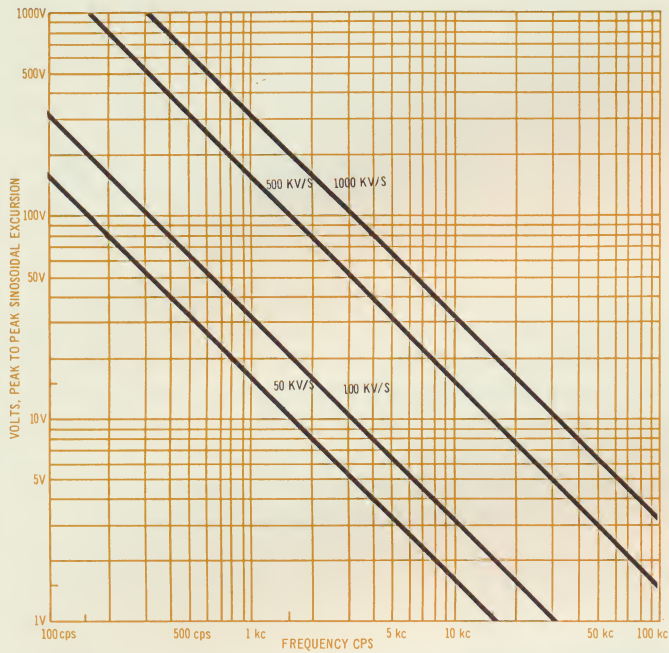


FIGURE 1: DYNAMIC SLEWING TO SINUSOIDAL FREQUENCY CHART

As an operational device, the input resistance of the Power Supply-turned amplifier is an inverse function of the desired gain ratio and is effectively equal to the value chosen for the input resistor (see Figure 2). (Gain equals feedback/input resistance). To adapt an existing high impedance dynamic microphone to this input, a single transistor stage, powered by the supply's own reference voltage (6.2V DC nominal) was constructed for a standard Model PAX 7-1CHS Power Supply, and mounted on the connector plug (refer to Figure 3).

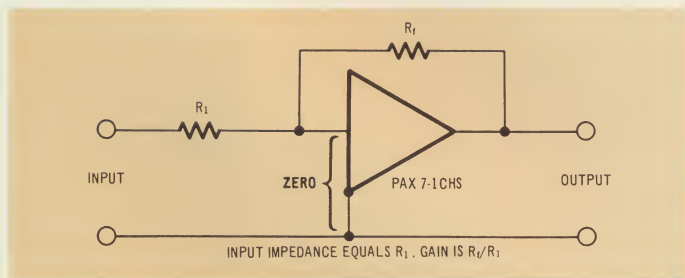


FIGURE 2: OPERATIONAL CONFIGURATION FOR PAX 7-1CHS

The Model PAX 7-1CHS is a high speed power supply module rated 0-7V DC, 0-1 ampere, and is set up as an adjustable gain amplifier with a range 0-1000. The pre-amp stage func-

tioned mostly as an impedance converter, delivering from 0.2 to 0.7 volts peak-to-peak to a 10K input resistor where the appropriate ratio of feedback to input resistance boosts it to a 7V peak-to-peak audio level at the output. To provide sufficient bias (3.5V DC) so that equal positive and "negative" excursions can be handled, a summing resistor is provided between the 6.2V DC reference, and the null junction of the amplifier (see Figure 3).

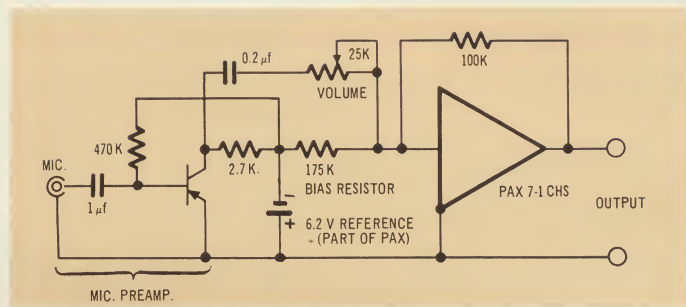


FIGURE 3: MICROPHONE PRE-AMP PLUG-IN ATTACHMENT WITH MODEL PAX 7-1CHS POWER SUPPLY

The output impedance of a Model PAX 7-1CHS Power Supply is a fairly close match for an 8 ohm speaker (7V/1A is 7 Ohms). This is quite different from the usual way of specifying a power supply's output impedance in which the incremental attenuation, or "damping" impedance is specified (a function of the internal inverse feedback). For audio power purposes, the *matching* impedance (for maximum power transfer) is more interesting. Higher output could have been obtained by using a Model OPS 15-1.5C Power Supply whose matching impedance would be 10 ohms.*

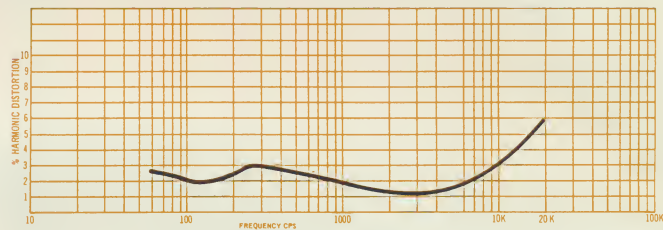


FIGURE 4: % HARMONIC DISTORTION.

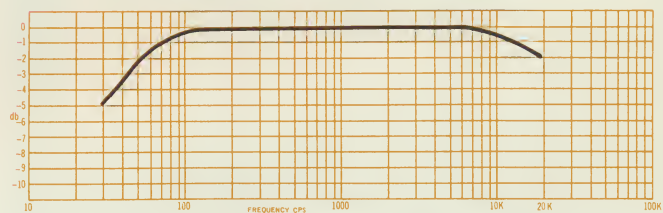


FIGURE 5: FREQUENCY RESPONSE

With microphone and speaker connected, the little PAX gave remarkable performance, filling, on occasion, some pretty good-size auditoriums with clear, undistorted audio. The measured bandwidth and distortion plots are reproduced as Figures 4 and 5. Partly, its good sound comes because of the excellent speaker damping provided by the low incremental impedance (0.02 ohms to 1 kc), plus the lack of low frequency phase shift owing to its DC coupling and lack of output transformer. The only important problem was the DC offset in the

Continued on Page 6 - Col. 1

*Editors Note: The new CK18-3MHs, announced elsewhere in these pages would be a fine match for a 6Ω speaker, also, (18V/3A = 6Ω) with a lot more output.

speaker cone, resulting from the unipolar nature of the equipment, and its consequent DC bias. This, purists declared, was not at all good for loud speakers (although the sound from ours seemed supremely indifferent to the fact that its voice coil was displaced). To eliminate this objection, a capacitive coupling circuit was devised, consisting of a pair of back-to-back electrolytic capacitors with a pair of clamping diodes to preserve their DC polarity. The diodes permit the use of large electrolytics to preserve a reasonable, low frequency (if not DC) response (see Figure 6).

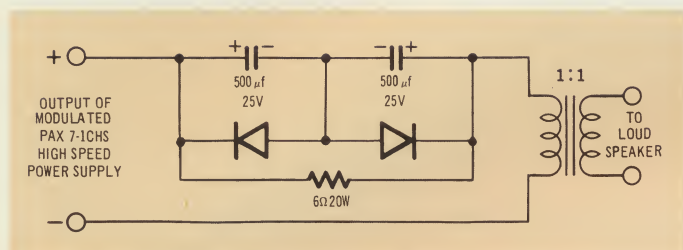


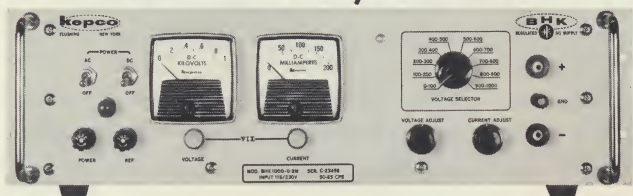
FIGURE 6: COUPLING CIRCUIT FOR LOUD SPEAKER.

When not on loan to run someone's stereo, Kepco's fast slewing power supplies can do some pretty fascinating signal/power processing jobs around most labs. In systems as amplifiers, comparators, sample and hold, integrators, etc., or on the bench serving as fast-responding current source—to avoid the damaging surges of conventionally filtered supplies—the new breed of high speed HS/OPS power supplies provide designers with new latitude and choice.

NEW KEPCO PRODUCTS for '67

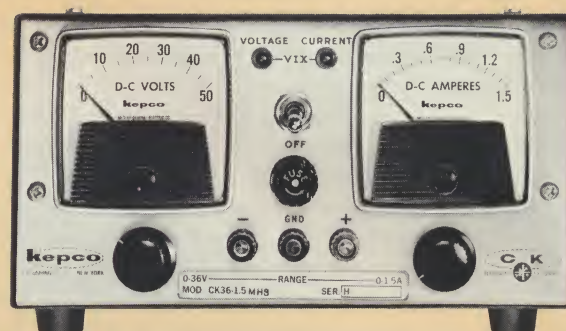
Kepco introduced a number of new products at the recent I.E.E.E. show in New York. These products include advanced concepts in fast slewing Automatic Crossover Power Supply/Amplifiers and applications.

NEW HIGH-VOLTAGE OPERATIONAL POWER SUPPLY/AMPLIFIER



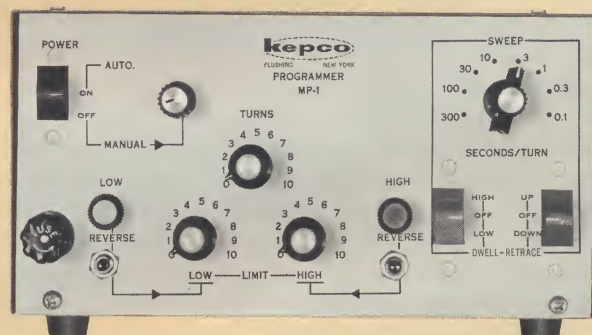
A new series of "BHK" hybrid regulators comprise Kepco's new precision regulated, high voltage **AUTOMATIC CROSS-OVER** Power Supply/Amplifiers featuring 0.01% regulation in both voltage and current modes, and equipped with mode indicator VIX® lights. Special terminals are provided to select either a fast slewing mode (for speeds in excess of 0.5 volts per microsecond), or a normal speed power supply mode. The fast slewing mode is particularly useful for current regulation and for applications requiring a wide-band, high voltage unipolar DC amplifier. Three models, in the range of 0-500V/0-400mA, 0-1000V/0-200mA and 0-2000V/0-100mA are available. For complete specifications, write for new Brochure #146-1168. (See story on Page 1).

NEW CK HIGH SPEED DESIGN GROUP



A new group of five **HIGH-SPEED** models from the Kepco CK Series provide greatly improved slewing speed and bandwidth characteristics. While standard CK power supplies can be programmed with a maximum slewing speed of 200 to 500V/sec., the five new fast slewing CK models are capable of speeds in excess of 100,000V/sec. This high speed is achieved by eliminating the output filter capacitor and compensating for stability with additional lag networks. The new circuitry emphasizes unipolar DC amplifier characteristics, and provides increased bandwidth for ideal current regulation. For complete specifications, write for new Brochure #146-1168.

NEW MOTORIZED PROGRAMMERS MECHANICAL FUNCTION GENERATORS



Two mechanical programmers have been made available for scanning resistance controlled functions. Designed primarily to sweep the output of DC power supplies, Model MP-1 operates with sweeps from 1-3000 seconds and Model MP-10 sweeps 10 to 30,000 seconds. Both units operate with a synchronous motor drive through a selectable speed gear box with adjustable end points (limits). Dwells and retrace, plus manual override controls are provided in an attractive "half-rack" package. For detailed specifications, write:

KEPCO, INC.

131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352

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